REMARKS

In the amendments above, Claim 23 has been added, Claim 17 has been cancelled and Claims 10, 11, 13,14, 16, and 18-21 have been amended, to more particularly point out and distinctly claim Applicants' invention. Claims 1-9 had been cancelled by previous amendment. Support for the amendments to Claims 10 and 19 may be found on page 7, line 25, to page 8, line 26, of the specification as filed. Support for new Claim 23 may be found on page 8, lines 6-10, of the specification as filed.

35 U.S.C. § 103 Rejections

Claims 10, 15, 16 and 18 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Rose-Pehrsson et al., U.S. Patent No. 5,469,369 ("Rose-Pehrsson") in view of Enquist et al., U.S. Patent No. 6,484,563 ("Enquist"). The Examiner maintains that with respect to Claim 10, Rose-Pehrsson teaches an analyzing system for the detection of reducing and oxidizing gases in a carrier gas which comprises a plurality of detecting means, calibrating means, a sealed measuring chamber, means for processing and control of acquisition and data recognition, wherein said gas-detection means are sensors based on semiconductor-type metal oxides, which are located into said measuring chamber, wherein the measurements on said carrier gas are taken inside said chamber without the need to introduce additional oxygen into the sensors' structures, when said sensors are exposed to a carrier gas flow of constant value and wherein said means of processing and control include a system of real time recognition of said gases , which provides a diagram with defined decision zones, in which measurements taken on said carrier gas are situated and identified.

With regard to Claim 15, the Examiner maintains that Rose-Pehrsson teaches wherein said processing and control means include a microprocessor that corrects temporary deviations of the sensor responses and controls and processes the data that permit detection of the presence of reducing and/or oxidizing gases at pre-existing levels. With regard to Claim 16, the Examiner maintains that Rose-Pehrsson additionally teaches

wherein said connecting means comprise a plurality of electrically operated valves and connecting pipes to permit the carrier gas or calibrated gases to flow through the chamber that contains the sensors. With respect to Claims 10 and 18, the Examiner maintains that although Rose-Pehrsson does not teach wherein a carrier gas has an oxygen content not exceeding 30 ppm of oxygen and the utilization of a gas sensor based on semiconductor-type metal oxides proposed for detecting reducing and oxidizing gases present in a carrier gas having an oxygen content not exceeding 30 ppm of oxygen, it would have been obvious for one of ordinary skill in the art, at the time the invention was made for to combine Rose-Pehrsson with Enquist, which teaches a carrier gas not exceeding 30 ppm of oxygen.

Claims 11, 12, 19, and 22 were further rejected under 35 U.S.C. § 103(a) as being unpatentable over Rose-Pehrsson and Enquist, and further in view of Llobet et al., "Quantitative vapor analysis using the transient response of non-selective thick-film tin oxide gas sensors;" June 16-19, 1997, Solid State Sensors and Actuators, 1997, International Conference on Solid-State Sensors and Actuator, pages 971-974 ("Llobet"). With regard to Claim 11, the Examiner maintains that Rose-Pehrsson teaches wherein said calibration means include a plurality of patterns or calibrated gases at least equal in number to the number of reducing or oxidizing gases that have to be detected in the carrier gas, wherein the response of the plurality of sensors to the measurements and patterns includes the obtaining if a vector for each calibrated gas or standard. With regard to Claims 11 and 12, the Examiner maintains that it would have been obvious to one of ordinary skill in the art, at the time the invention was made, to have substituted the conductance variation and conductance rise time values of Llobet into the sensor response elements and patterns within the learning matrix of the system taught and made obvious by Rose-Pehrsson in order to implement the pattern recognition algorithm because, when used together, steady state conductance variations and transient conductance rise times lead to an improved level of classification accuracy over using solely sensor resistances when analyzing results. With regard to Claim 19, the Examiner maintains that it would have been obvious to one of ordinary skill in the art for Rose-

Pehrsson to have used a carrier gas not exceeding 30 ppm of oxygen as in Enquist because the semiconductor will provide greater signal and that it would have been obvious to substitute the conductance variance and conductance rise time values of Llobet et al into the sensor response elements of the pattern vectors within the learning matrix of the system taught and made obvious by Rose-Pehrsson in order to implement the pattern recognition algorithm because, when used together, steady-state conductance variations and transient conductance rise times lead to an improved level of classification and accuracy.

Claims 13 and 14 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Rose-Pehrsson, Enquist, and Llobet, and further in view of Lewis et al., U.S. Patent No. 5,959,191 ("Lewis"). The Examiner states that Lewis teaches a system with sensor arrays for detecting an analyte in a fluid for use in conjunction with an electrical measuring apparatus. The Examiner maintains that it would have been obvious to one of ordinary skill in the art at the time the invention was made to have substituted the steps of autoscaling, principle component analysis, and gas identification from sensor responses of Lewis into the data processing of the learning matrix and pattern vectors carried out under the system taught and made obvious by Rose-Pehrsson, Enquist, and Llobet.

Claim 17 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Rose-Pehrsson and Enquist further in view of Kurokawa et al., U.S. Patent No. 6,679,097 ("Kurokawa"). The Examiner maintains that it would have been obvious to one of ordinary skill in the art at the time the invention was made to have substituted the carbon dioxide carrier gas of Kurokawa for the carrier gas of Rose-Pehrsson because, when the system is applied to the beverage industry, carbon dioxide will not affect the flavor of the beverage.

Claims 20 and 21 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Rose-Pehrsson, Enquist, and Llobet further in view of Lewis. The Examiner maintains that it would have been obvious to one of ordinary skill in the art at

the time the invention was made to have substituted the steps of autoscaling, principle component analysis, and gas identification from sensor responses of Lewis into the data processing of the learning matrix and pattern vectors carrier our under the system taught and made obvious by Rose-Pehrsson, Enquist and Llobet.

Applicants respectfully traverse the rejections above and respectfully request reconsideration for at least the reasons set forth below.

Applicants have carefully taken into consideration the comments of the Examiner regarding the provision of particular details on the claimed sensor's structure and on the claimed chemical mechanism involved in the functionality in the absence of oxygen (see, page 11 of the Office Action).

At this end, Applicants propose new independent Claims 10 and 19 directed to an analysing system for the detection of pollutant gases in a carbon dioxide gas flow, including, among others, the following features;

- a plurality of gas sensors which are *"...chemiresistor gas sensors each of them comprising a semiconductor-type metal-oxide active layer, metallic electrodes to monitor the changes in the electrical conductivity (resistance) of the semiconductor layer and heating means, ..."*,

and a sensing mechanism wherein it:

- *"...involves the monitoring of the conductivity (resistance) changes of each sensor which take place in response to the presence of pollutant gases contained in said carbon dioxide gas flow, and which take place without the need to introduce additional oxygen into the sensor's structures during measurement, ..."*

As disclosed in Wilson (see, fig.1 of page 260) and as previously explained, the general accepted working mechanism of metal-oxide semiconductor type sensors involves the presence of oxygen in the ambient. In the presence of oxygen (typically in air), oxygen atoms from the ambient are adsorbed on the surface of the metal oxide. Oxygen atoms are in fact ionosorbed, which means that they abstract electrons from the conduction band of the metal oxide. In pure air, an equilibrium concentration of adsorbed oxygen is reached at the

surface of the metal oxide, thus determining a baseline conductivity. In the presence of traces of reducing or oxidizing gases in the ambient environment, a different equilibrium concentration of oxygen adsorbed at the surface is reached, which results in a conductivity change.

Applicants have found that when the metal-oxide semiconductor sensors are exposed to a carbon dioxide gas flow with negligible amounts of oxygen (not exceeding 30 ppm) a baseline conductivity is reached in absence of oxygen adsorbates in the metal-oxide. In the presence of a given concentration of pollutant gas in the carbon dioxide gas, an equilibrium concentration of adsorbed pollutant is reached where the species is adsorbed at the surface of the metal-oxide, which results in a conductivity change as there is a charge transfer from each pollutant adsorbate to the metal-oxide and a new value for the conductivity of the metal-oxide is reached.

As noted in the specification, it has been observed that carbon dioxide interacts reversibly with the surface of the metal-oxide semiconductor, acting in a similar way to oxygen in the detection of traces of pollutant (reducing and oxidizing gases). In the present invention, the changes of conductivity of the metal-oxide of the sensors unexpectedly take place in response to the presence of pollutants without the need that oxygen adsorbates are present.

Applicants note that none of the references cited by the Examiner, either alone, or in combination, teach the claimed invention as recited by Claims 10 and 19.

The Examiner maintains that Rose-Pehrsson discloses an alternative embodiment incorporating chemiresistors. Applicants note that while Rose-Pehrsson suggests the use of chemiresistor gas sensors as an alternative embodiment, Rose-Pehrsson does not teach that such chemiresistor gas sensors are metal-oxide semiconductor gas sensors comprising metallic electrodes to monitor the changes in the electrical conductivity of the semiconductor layer as taught by presently amended Claims 10 and 19.

Even if it is assumed that the suggested chemiresistor gas sensors of Rose-Pehrsson are metal-oxide sensors, nothing in Rose-Pehrsson suggests that such sensors would be exposed to a carbon dioxide gas flow with negligible amounts of oxygen. As disclosed in Column 5, lines 28-44, of Rose-Pehrsson, such sensors would be exposed to vapor samples containing air as a carrier gas and the sensors would operate as expected by generally accepted working principles which involve the presence of oxygen as disclosed in Wilson. Rose-Pehrsson teaches a system wherein the carrier gas is sample air collected from the environment to be tested and drawn into the system through a manifold or tube preconcentrator by means of pumps with a small pump being necessary to pull samples into the sensor array. The vapor samples collected by the pump are generated by using air which is not a form of pure or contaminated carbon dioxide, but is simply air from the environment. The sensing mechanism as conceived by Rose-Pehrsson is not attuned to detect the conductivity changes which take place in response to the presence of pollutant gases contained in carbon dioxide gas flow. Accordingly, with respect to independent Claims 10 and 19, Rose-Pehrsson fails to teach or suggest a system for the detection of pollutant gases in a carbon dioxide gas flow whose quality is to be evaluated.

The Examiner maintains that Enquist teaches a metal-oxide semiconductor type sensor wherein the carrier gas is free of oxygen and wherein utilization of a gas sensor based on semiconductor-type metal oxides is proposed for detecting reducing and oxidizing gases present in a carrier gas having an oxygen content not exceeding 30 ppm of oxygen.

Applicants note that with respect to independent Claims 10 and 19, as currently amended, Enquist fails to teach or suggest a system with gas sensors comprising a metal-oxide semiconductor type active layer, metallic electrodes to monitor the changes in the electrical conductivity of the semiconductor active layer, and heating means.

Enquist teaches, in Column 3, lines 32-34, a method wherein the measurement is performed after the exposure of the semiconductor sensor to the gas of free oxygen. In

Column 3, lines 7-11, Enquist further discloses the exposure of a gas which is free of oxygen and carbon monoxide at a point before the measurements take place, and Enquist aims to remove oxygen and carbon monoxide molecules, which may be adsorbed to the metal surface of the sensor and subsequently influence the output signal of the hydrogen detector. The Examiner maintains that Enquist teaches a system wherein the carrier gas is free of oxygen.

Applicants note that the system of Enquist teaches a gas with negligible amounts of oxygen, but Applicants further point out that nothing in Enquist suggests or teaches that such an atmosphere or gas is a carrier gas to be used to perform the measurements nor that such a gas is a carbon dioxide gas flow. On the contrary, Enquist teaches that the atmosphere is an inert gas such as argon, helium, or nitrogen, that is to be used on the preconditioning period before the measurements take place (Enquist, Col. 4, lines 7-8). Accordingly, with respect to independent Claim 10, as currently amended, Enquist fails to teach or suggest a system wherein the sensors are exposed to carbon dioxide gas flow having an oxygen content no exceeding 30 ppm of oxygen.

The Examiner further asserts that Enquist teaches a metal-oxide semiconductor type sensor. However, Applicants respectfully point out that the sensor of Enquist is not a sensor wherein the active layer is the metal-oxide semiconductor layer, and wherein the metallic electrodes are used to monitor the changes of conductivity of said metal-oxide layer. Rather, the active layer of the semiconductive layer of Enquist is a metallic electrode which captures hydrogen molecules and decomposes the molecules into hydrogen atoms, which diffuse through the metal layer and give rise to an electrical signal in the semiconductor structure. (Enquist, Col. 1, lines 35-40). In fact, Enquist, in Column 1, lines 31-35, refers to the type of sensor described in SE-7411342-4, which includes a semiconductor, a metal electrode, and an insulator situated between the conductor and the electrode. On this type of sensor, some of the hydrogen will be adsorbed on the surface of the metal electrode or gate electrode, diffuse through the electrode and be adsorbed on the electrode surface facing the insulator. The specific

property of the metal electrode is used in connection with a semiconductor having a field effect structure, the threshold voltage of which is dependent on the emissive power of their gate electrode.

Accordingly, with respect to independent Claims 10 and 19, Enquist fails to teach or suggest a system with gas sensors comprising a metal-oxide semiconductor type, active layer, metallic electrodes to monitor the changes in the electrical conductivity of the semiconductor active layer and heating means.

It would not have been obvious to one of ordinary skill in the art to combine the teachings of Rose-Pehrsson with the teachings of Enquist to arrive at the claimed invention. Again, Applicants note that Rose-Pehrsson does not teach the detection of pollutants in a carbon dioxide gas flow nor does Enquist teach the carbon dioxide gas as a gas free of oxygen to be used to perform the measurements of sensors with metal-oxide semiconductor layers.

The Examiner maintains that Kurokawa teaches a system wherein carbon dioxide or nitrogen gas, along with gas from the inside bottle are delivered to a measuring apparatus.

Applicants note, however, that Kurokawa fails to teach a system to monitor the quality of a carbon dioxide gas flow. In fact, Kurokawa teaches, in Column 6, lines 4-13, a system to monitor the oxygen concentration of the vapor phase in a storage tank, said vapor phase comprising, among other gases, carbon dioxide as a replacement gas. Thus, while Kurokawa teaches the monitoring of a gas comprising carbon dioxide, nothing in Kurokawa teaches or suggests the quality of such a carbon dioxide gas flow is to be monitored. In fact, in Column 2, lines 1-5, of Kurokawa, it is stated that carbon dioxide gas is a replacement gas whose quality must be known beforehand in order not to affect the quality of a beverage. Applicants note that the quality of the carbon dioxide gas in the present invention is being monitored; thus, it is not predetermined.

It would not have been obvious to one of ordinary skill in the art to combine the teachings of Kurokawa with the teachings of Rose-Pehrsson because nothing in Kurokawa suggests that such a carbon dioxide gas is a gas in which the quality of the gas must be evaluated using calibrated gases and metal-oxide semiconductor gas sensors and as noted above, Rose-Pehrsson teaches a system wherein vapor samples are generated by using air.

Accordingly, none of the references cited by the Examiner teach or suggest, alone or in combination, the claimed invention as recited in independent Claims 10 and 19. In view of the remarks presented above, it is respectfully submitted that independent Claims 10 and 19 are patentable over the cited references and as Claims 11-16, 18, and 20-23 depend directly or indirectly from Claims 10 and 19, they should be found patentable as well.

In view of the comments above and the amendments to the claims, it should be clearly appreciated that the claims herein are patentable over Rose-Pehrsson, Enquist, Llobet, Kurokawa, and Lewis. Accordingly, withdrawal of the rejections and allowance of the claims is believed proper.

Reconsideration and allowance of all the claims herein is respectfully requested.

Respectfully submitted,

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